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[54] DEVICE FOR CLAMPING A DISC-SHAPED TOOL

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[63] Continuation of Ser. No. 293,299, Jan. 4, 1989, abandoned.

[30] **Foreign Application Priority Data**

Jan. 9, 1988 [DE] Fed. Rep. of Germany 3800437

[51] **Int. Cl.**[5] **B24B 23/02**
[52] **U.S. Cl.** **51/168**; 83/666
[58] **Field of Search** ..... 51/168, 170 R, 170 PT, 51/170 T, 322; 83/666

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[57] **ABSTRACT**

A compact device for clamping a disc-shaped tool on a tool spindle of a portable machine tool with a clamping anchor arranged in the tool spindle, with a clamping flange attachable to the free end of the clamping anchor, with an abutment arranged at the tool end of the tool spindle and with a manual actuating mechanism for releasably pressing the clamping flange against the abutment, thereby clamping the tool between the clamping anchor and the tool spindle. The manual actuating mechanism includes a first pressure cylinder having a first cavity and a second pressure cylinder having a second cavity, and a connecting channel between the cavities. The second pressure cylinder includes a piston delimiting the second cavity. The piston is adjustable and fixable by the manual actuating mechanism from the tool end of the tool spindle for releasably clamping the tool on the tool spindle.

31 Claims, 3 Drawing Sheets

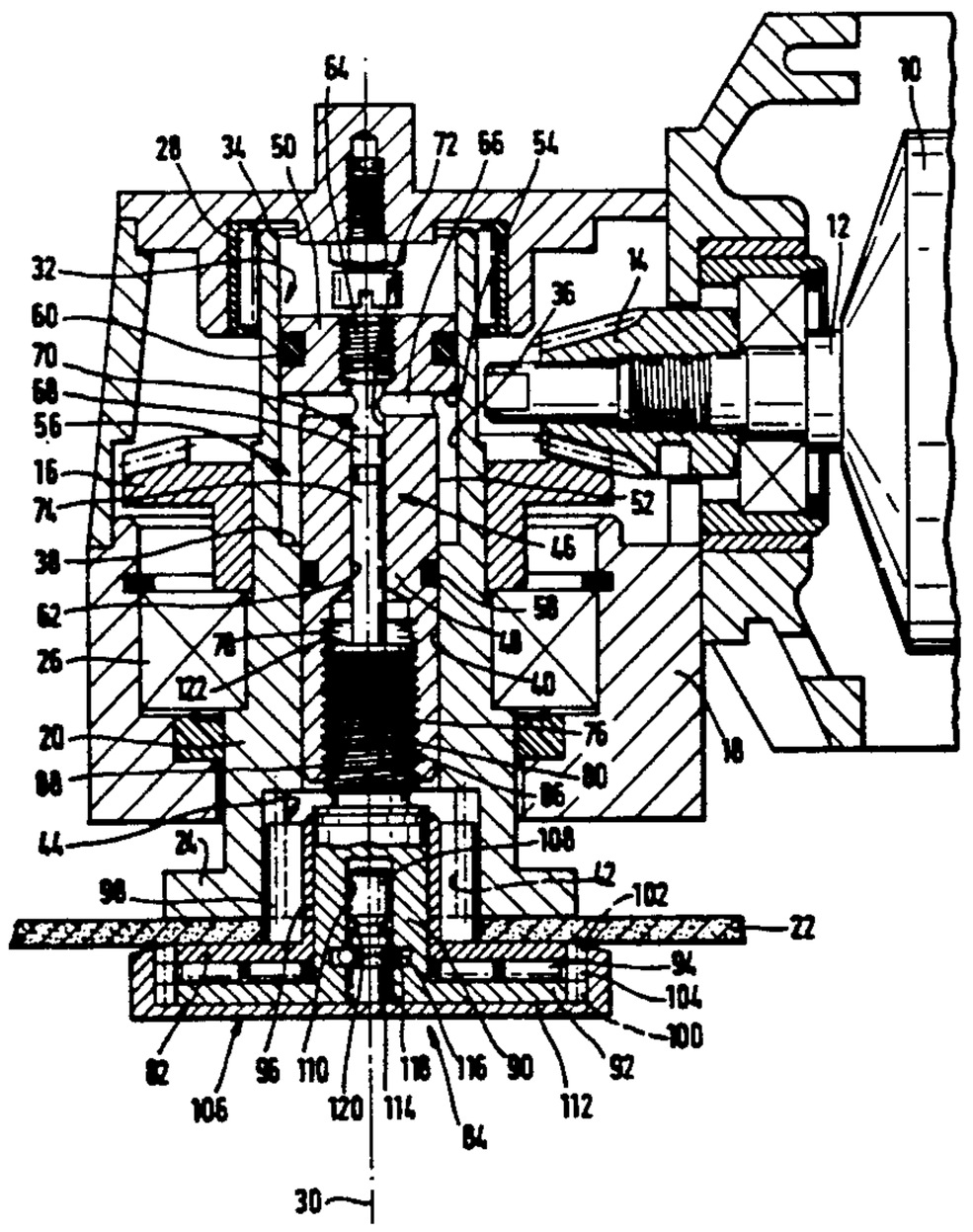

FIG.1

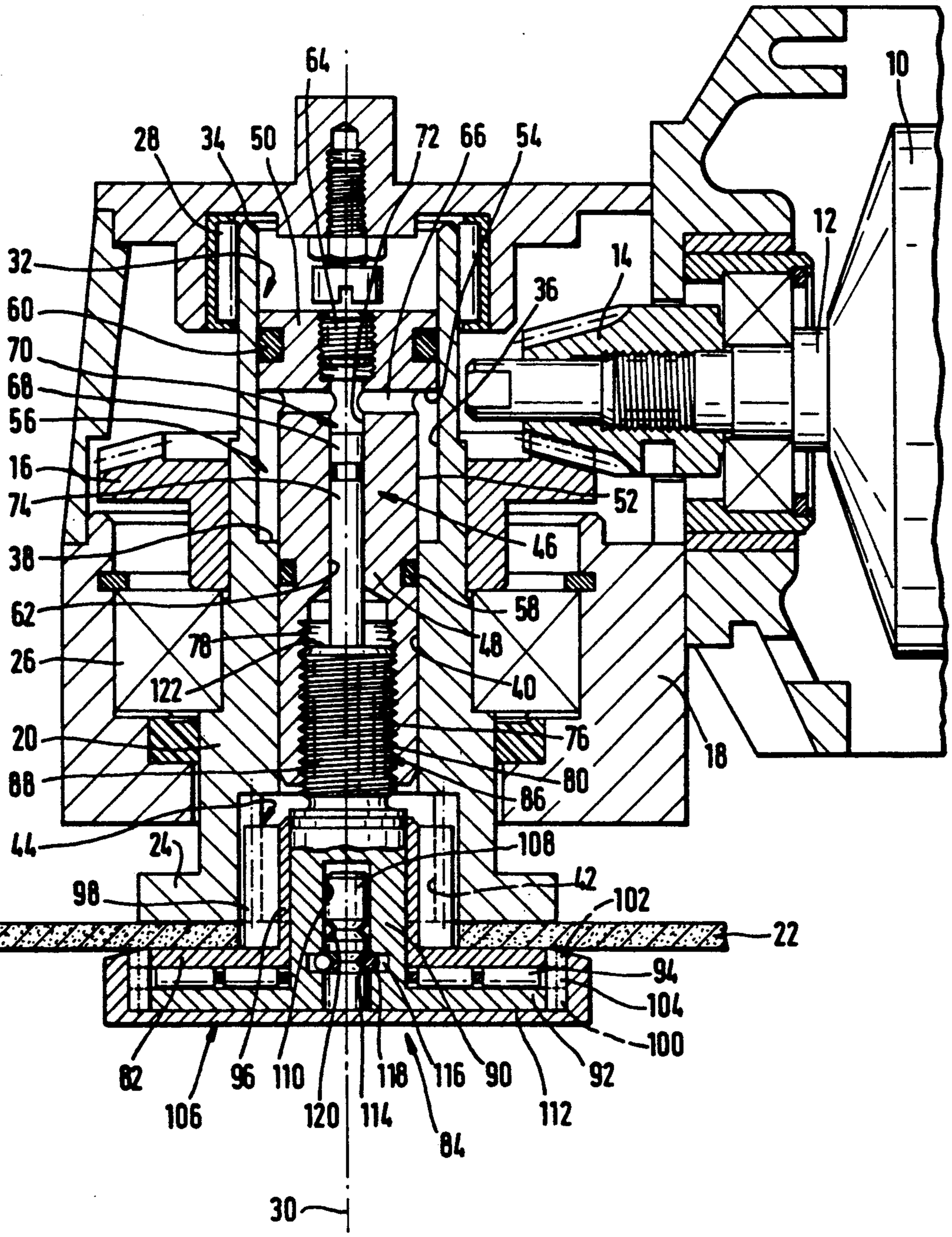
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FIG.2

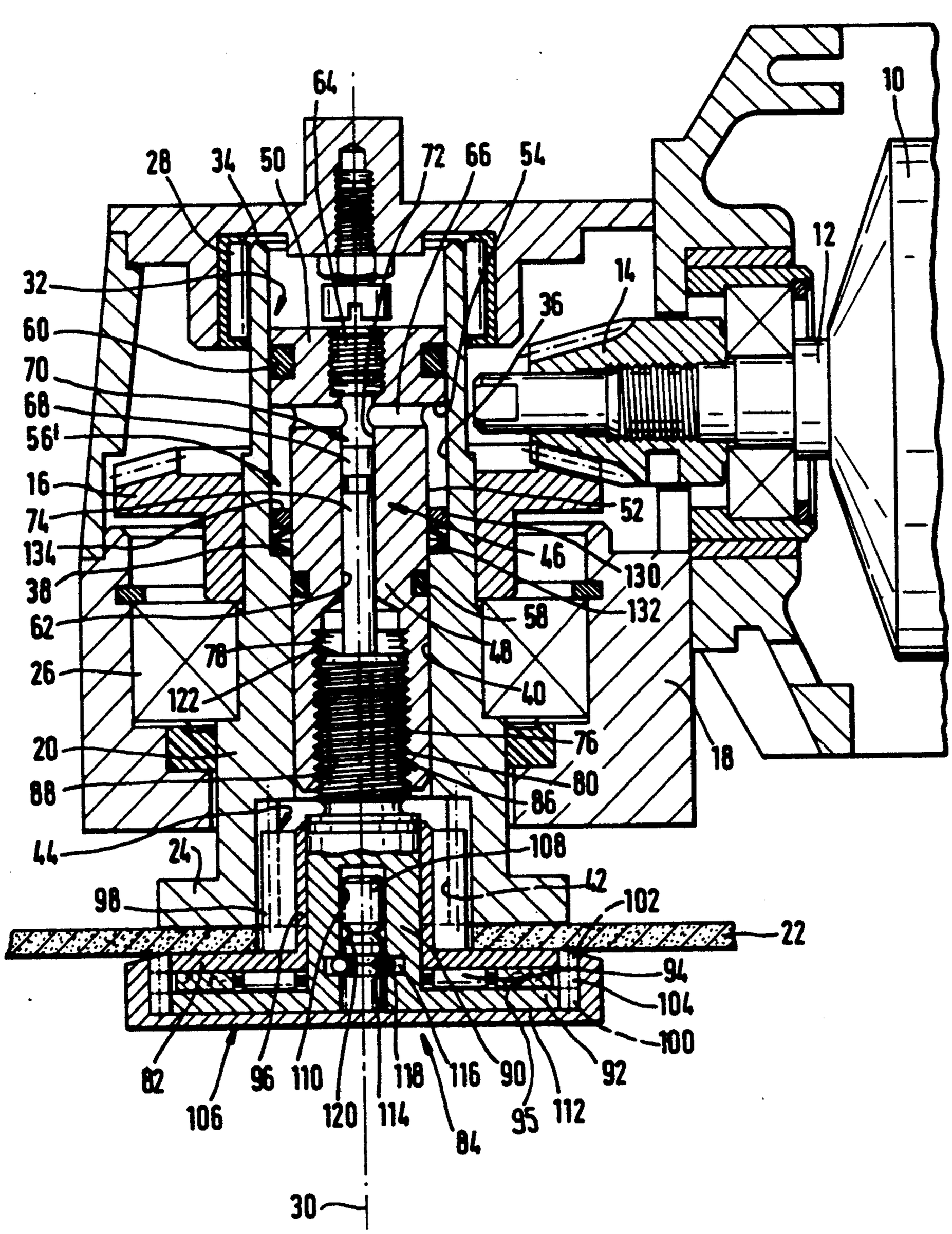
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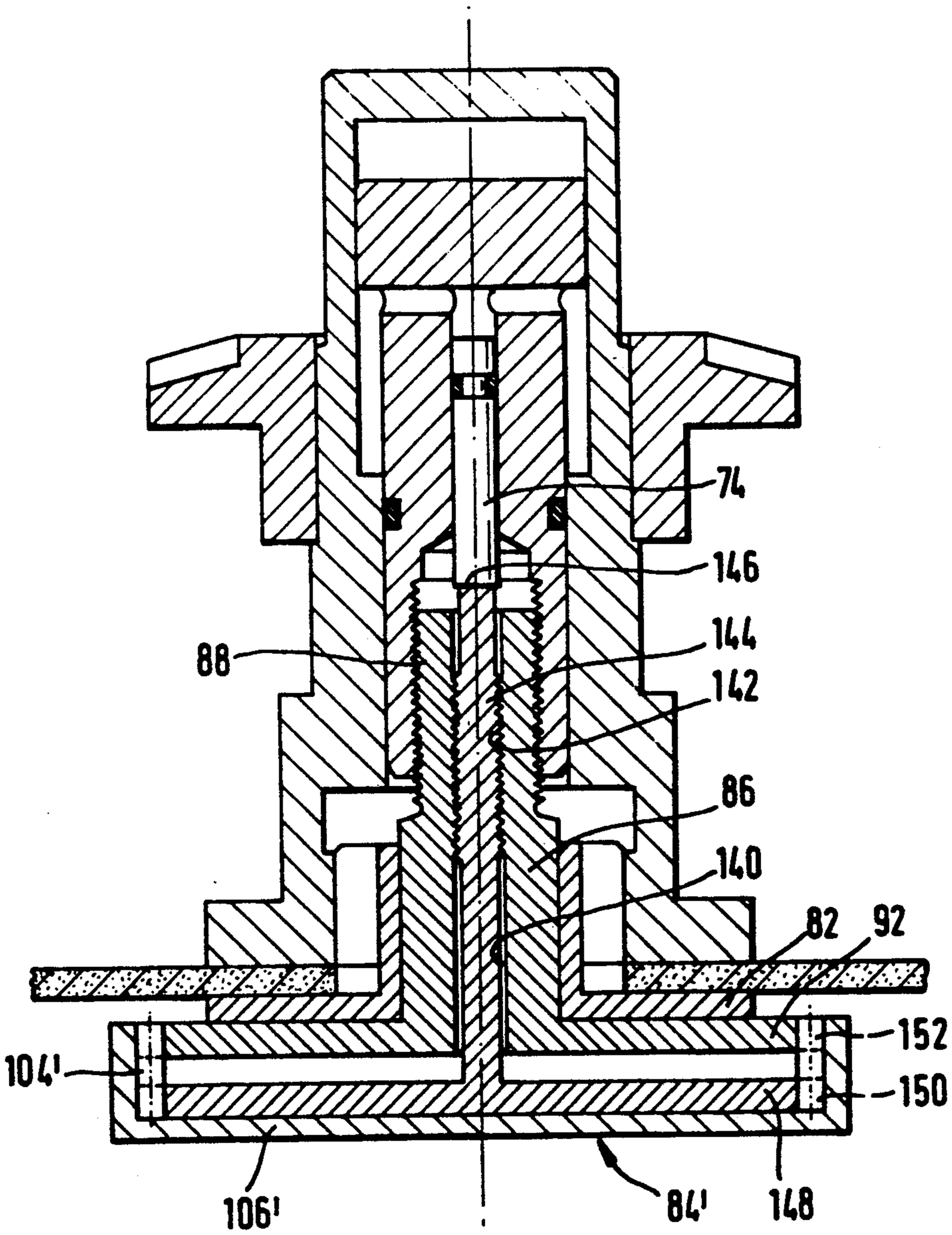
FIG. 3



DEVICE FOR CLAMPING A DISC-SHAPED TOOL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of copending, commonly-owned U.S. patent application Ser. No. 293,299, entitled "DEVICE FOR CLAMPING A DISC-SHAPED TOOL", filed Jan. 4, 1989, now abandoned.

BACKGROUND OF THE INVENTION

The invention relates to a device for clamping a disc-shaped tool on a motor-driven tool spindle of a portable machine tool, in particular, a grinding disc on an angle grinder, with a clamping anchor arranged in the tool spindle which has an axial recess, the clamping anchor being axially displaceable relative to the tool spindle and rotationally fixedly connected to the tool spindle, with a clamping flange which is releasable attachable to the free end of the clamping anchor, with an abutment arranged at the tool end of the tool spindle and with a means actuatable by a manual actuating mechanism for releasably pressing the clamping flange against the abutment, thereby clamping the tool between these.

Such a device is known from German Patent 3 405 885. Herein, the clamping anchor arranged in the tool spindle in the form of a hollow spindle is pushed by a pressure spring similarly arranged in the tool spindle so that a clamping flange attachable to the clamping anchor clamps the disc-shaped tool against an abutment on the tool spindle. Therefore, in this device, the clamping force is generated by a spring arranged in the hollow spindle. The clamping anchor can be pushed against the force of the pressure spring by the actuating mechanism so that the clamping flange can be easily released or untightened by hand and, consequently, attachment of the disc-shaped tool is possible without additional tools.

Clamping of the clamping anchor by means of the known spring requires a manual actuating mechanism which is fixedly arranged on the housing on the side opposite the tool and enables a force acting against the spring to be manually applied. This type of actuation, therefore, opposes a compact design of the complete device.

The object underlying the invention is, therefore, to design the known device for attaching a disc-shaped grinding tool which does not require an auxiliary tool for releasing or tightening the tool attachment in as compact a manner as possible and, in particular, in such a way that it is hydraulically actuatable.

DISCLOSURE OF THE INVENTION

This object is achieved, in accordance with the invention, in a device of the kind described at the beginning in that the means comprises a first pressure cylinder including a first cavity between the clamping anchor and the tool spindle, a second pressure cylinder including a second cavity arranged in the clamping anchor or the tool spindle and a connecting channel between the two cavities, in that the second pressure cylinder includes a piston arranged in the second cavity, and in that in order to effect the clamping, the piston is adjustable and fixable in its position in which it clamps the tool by the manual actuating mechanism from a tool end of the tool spindle.

A clamping device is known from German Utility Model 69 18 532 for clamping a tool arranged on a machine part by cooperation of a first and a second pressure cylinder and also an actuating device. However, this clamping device is always arranged such that the tool is positioned between the clamping device itself and the machine part, i.e., for example, the tool spindle. Therefore, the entire clamping device is arranged opposite the tool spindle with respect to the tool and sits directly on the tool and can, consequently, press the tool against the tool spindle.

Hence the German Utility Model 69 18 532 cannot anticipate the special design of the tool spindle and the clamping anchor guided therein and also the arrangement of the two pressure cylinders within the tool spindle with an axial recess, as is the subject of the present invention.

Accordingly, the gist of the invention is that both pressure cylinders are arranged in the tool spindle which is necessary in any case, that both pressure cylinders are actuatable from a tool end of the tool spindle, that both in the position clamping the tool and in the position not clamping the tool, both pressure cylinders communicate with one another and correspond with one another, and that during the clamping, the actuatable piston of the second pressure cylinder acts upon a pressure medium arranged in both pressure cylinders and in the connecting channel and the pressure medium in the second pressure cylinder causes the clamping anchor to move from its position in which it does not clamp the tool into its position in which it clamps the tool. A reduction ratio is preferably provided between the second and the first pressure cylinders, i.e., a smaller force in the second pressure cylinder acting on the piston during actuation results in a larger force being exerted on the clamping anchor in the first pressure cylinder.

An embodiment wherein the first cavity is defined by delimiting surfaces of the tool spindle and the clamping anchor which face each other and are arranged in axially spaced relation to each other and by corresponding circumferential surfaces of the clamping anchor and the tool spindle is particularly preferred.

A solution which is particularly simple from a structural point of view is achieved by the delimiting surface of the clamping anchor facing the tool while the delimiting surface of the tool spindle faces away from the tool so that a volume dilatation in the first cavity results in the delimiting surface of the clamping anchor being moved away from the tool and hence the clamping anchor can carry out an axial displacement which directly clamps the tool.

Adjustment of the piston is advantageously carried out via a bore which is open at the tool end and extends in the clamping anchor or in the tool spindle as far as the piston and through which the manual actuating mechanism extends.

In the embodiments described so far, no details have been given of the mechanism by means of which the piston is to be actuated. In a preferred embodiment, the manual actuating mechanism is arranged in a region of the clamping anchor or the tool spindle at the tool end.

Operation of the inventive device is achievable in a particularly expedient manner by the manual actuating mechanism being accessible for operation from the side of the tool facing away from the tool spindle.

In particular, this manual actuating mechanism is designed so as to be operable via a retaining device which is releasably attachable to the clamping anchor

for securing the clamping flange on the clamping anchor since such a releasably attachable retaining device is necessary in any case. In this way, an optimal compact design is achieved since both the entire means for pressing the clamping flange against the abutment, thereby clamping the tool between these, and the manual actuating mechanism for this means are integrated in parts which are normally necessary in such a portable machine tool in any case and, consequently, there is practically no increase in volume in the inventive solution.

The inventive manual actuating mechanism can be particularly well integrated in a portable machine tool if the manual actuating mechanism includes an adjustable clamping member which acts upon the piston in order to effect clamping.

Adjustment of the clamping member may be carried out in many different ways. It is, for example, conceivable for the clamping member to be acted upon directly by hand and to be lockable in its actuated position. Simpler operability of the clamping member which, above all, requires less force is possible if the clamping member comprises a surface oriented at an incline to a direction of adjustment of the piston. This surface may, for example, be the circumferential surface of an eccentric, via which the piston is actuatable, for example, by means of a piston rod. The inclined surface may, however, also be an abutment surface which is displaceable transversely to the direction of adjustment of the piston and likewise acts, for example, on a piston rod in order to adjust the piston.

The simplest way of implementing the inclined surface is for the clamping member to comprise a thread and for its thread surfaces to then form the inclined surfaces.

Within the scope of the manual actuating mechanism, the clamping member itself may be arranged at different locations. In one possible embodiment according to the invention, the clamping member is arranged in the clamping anchor or in the tool spindle, more particularly, in the bore extending as far as the piston.

In an alternative solution according to the invention, the clamping member is arranged on the retaining device.

In the inventive solutions described so far, no details of the arrangement of the clamping flange have been given. It is, for example, expedient for the retaining device to include the clamping flange.

To enable this clamping flange to be attached to the clamping anchor, the retaining device comprises a retaining member which is securable against axial displacement in a positively connected manner on the clamping anchor. The retaining member may be designed in many different ways. It is, for example, possible for the retaining member to be connectable to the clamping anchor in the form of a bayonet joint.

In a structural alternative, the retaining member can be screwed into the clamping anchor.

In a particularly preferred embodiment of a manual actuating mechanism, the clamping member and the retaining member are the same screw and, therefore, both attachment of the clamping flange to the clamping anchor and simultaneous actuation of the piston are effected by screwing this screw into the clamping anchor.

Herein, it is particularly advantageous for the screw to be screwable into a first and an adjoining second threaded section of the clamping anchor and for the piston to be actuatable when the screw is screwed into the second threaded section. The great advantage of such a structural solution is that the clamping flange can first be roughly secured on the clamping anchor and further tightening of the screw causes actuation of the piston which then results in final clamping of the tool.

In this embodiment, it is advantageous for the clamping flange to be held on the retaining member in such a manner that it can be turned and acted upon by the retaining member in the direction of the tool. This is necessary in order to prevent frictional forces between the tool and the screw itself from impeding rotation of the retaining member when the tool is being secured. If, however, the clamping flange held rotatably on the retaining member rests on the tool, then the retaining member can still be designed so as to be easily rotatable relative to the clamping flange even if it acts, for example, with a shoulder on the clamping flange.

The retaining member can be turned particularly easily if an axial thrust bearing is arranged between the screw and the clamping flange.

In order to prevent the clamping flange from being able to turn relative to the tool spindle, which is necessary particularly when the tool spindle of the inventive portable machine tool can be rotatably driven in opposite directions or when a braking device is provided for the tool spindle, it is advantageous for the clamping flange to be rotationally fixedly securable on the tool spindle by means of positive connection elements. For safety reasons, it is also expedient in many cases for rotation of the clamping member relative to the clamping flange to be eliminated during operation. For this reason, the clamping member is securable against rotation on the clamping flange.

The simplest form of effecting such securing is for the clamping member to be securable in a positively connected manner on the clamping flange.

Such securing by positive connection is conceivable in any chosen manner. It is, for example, possible to provide a detent means which is radially displaceable in relation to the tool spindle.

It is, however, particularly expedient for the clamping member to be securable by a securing element which is displaceable in the axial direction and which may, for example, be a bolt which engages bores in both the clamping member and the clamping flange.

With such a variant, however, securing would only be possible in certain relative positions between clamping member and clamping flange. For this reason, provision is expediently made within the scope of the above embodiment for the securing element to be rotationally fixedly and axially displaceably held on the clamping member or on the clamping flange and to be engageable with a toothed rim of the clamping flange or the clamping member which is coaxial with their axis of rotation. Hence securing of the clamping member is possible in angular positions corresponding to an angular spacing of successive teeth of the toothed rim.

Finally, it is advantageous for the securing element to be lockable in its position in which it secures the screw.

In a further preferred embodiment as an alternative to the embodiment in which the clamping member and the retaining member are one and the same screw, the clamping member is adjustable relative to the retaining member and, in particular, variants in which the clamping member is screwable into the retaining member are conceivable.

In this embodiment, it is not necessary to turn the retaining member after the tool has been placed against the abutment for final clamping of the tool, and, therefore, in a simple embodiment it is sufficient for the clamping flange to be formed on the retaining member.

Alternatively, however, as in the embodiment described above, provision may be made for the clamping flange to be rotatable relative to the retaining member and so, in particular, with tool spindles which are rotatable in opposite directions or also braked tool spindles, the clamping flange can be rotatably fixable by positive connection on the tool spindle.

In an expedient embodiment of the present invention which is particularly simple from a structural point of view, the clamping member is a threaded spindle with an actuating element protruding beyond the retaining member and so by turning the actuating element, the threaded spindle can be screwed into a position in which it acts upon the piston to clamp the tool and can be screwed out to release it. Hence it is sufficient for the retaining member to be axially fixed in a positively connected manner on the clamping anchor and for the final clamping of the tool by means of a decrease in size of the second cavity and an increase in size of the first cavity to be brought about by screwing in the threaded spindle, as a result of which the entire clamping anchor is moved away from the tool and, consequently, the tool is clamped by the retaining member fixed on the clamping anchor and the clamping flange connected to the retaining member.

For safety reasons, it is, furthermore, advantageous for the clamping member to be rotationally fixedly securable on the retaining member by a securing element and in this case it is expedient for the clamping member to be securable in a rotationally fixed manner by positive connection.

As described above, such a securing element may be designed in different ways but within the scope of the present invention, a securing element which is displacable in the axial direction is preferred.

The simplest and most expedient securing element design is a cap which engages over the actuating element of the clamping member.

In an improved embodiment, the securing element is additionally lockable in its position in which it fixes the clamping member.

In all of the embodiments described above, details were not given of which pressure medium is to be provided in the first cavity, the second cavity and the connecting channel.

In a preferred embodiment, the first and the second cavities and also the connecting channel are filled with a plastic substance for hydraulic pressure transfer. This is, in particular, expedient because portable machine tools should be operable where large temperature differences prevail and in such instances should also function reliably. Use of a conventional hydraulic oil results in sealing problems in the pressure cylinders which can only be solved with great difficulty if at all. The advantage of the plastic substance is that it eliminates such sealing problems.

A polyvinyl chloride with a relatively low degree of polymerization is particularly preferred as plastic substance.

Alternatively, it is, however, similarly conceivable for the first cavity, the second cavity and the connecting channel to be filled with a viscous substance as this also eliminates the sealing problems referred to above. The viscous substance is preferably a silicon substance, more particularly, a silicon lubricant.

In addition, it is advantageous for the plastic or viscous substances to be compressible as these then result in an elastic clamping of the tool which adapts to different expansions of the individual parts.

However, to enable substantially incompressible pressure transfer media to also be used in the inventive solution, a variant of the solution according to the invention features an elastic element which permits axial displacement of the clamping flange relative to the tool spindle. This element may be arranged at very different locations. It is, for example, conceivable for this element to be arranged between the clamping flange and the retaining member which acts upon it.

This elastic element is preferably of such dimensions that it is compressible up to inelasticity while the tool is being clamped. In this way, an even larger path is achievable in the clamping procedure and, in addition, when incomplete clamping of the tool has been effected with the inventive device, this elastic element ensures that the tool still rotates with the tool spindle, which prevents all kinds of accidents owing to faulty clamping.

In a particularly simple embodiment, the elastic element is a volume-elastic element arranged in one of the cavities so that the volume-elastic element is first compressed and the final clamping of the tool is then effected by the volume compression.

Further features and advantages of the invention are the subject of the following description and the appended drawings of several embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of a first embodiment of the invention.

FIG. **2** is a section similar to FIG. **1** through a second embodiment.

FIG. **3** is a section similar to FIG. **1** through tool spindle, clamping anchor and retaining device of a third embodiment.

DETAILED DESCRIPTION OF THE INVENTION

A first embodiment of an inventive angle grinder, illustrated in FIG. **1**, comprises a drive motor **10**, partly illustrated in the drawing, with a drive shaft **12** which via a drive pinion **14** drives a bevel gear **16** of a tool spindle **20** which is rotatably mounted in a gear housing **18**. This tool spindle **20** comprises at one end a flange **24** serving as abutment for a tool, in particular, a grinding disc **22**. The tool spindle **20** is supported in the gear housing **18** on one side facing the flange **24** by means of a bottom bearing **26** and on a side facing away from the flange **24** by means of a top bearing **28** arranged in spaced relation to the bottom bearing **26**. Hence the tool spindle **20** is rotatable about an axis **30**.

The tool spindle **20** in the form of a hollow spindle comprises a coaxial central recess **32** which with a widened section **36** extends into the tool spindle **20** from an end **34** located opposite to the flange **24** and hence to the tool **22**, passes via a stepped surface **38** into a central section **40** of smaller diameter than the widened section **36** and following the central section **40** widens in the region of the flange **24** to a toothed section **44** which is provided with an internal toothing **42** and is open towards the tool **22**.

A clamping anchor **46** is axially displaceably but rotationally fixedly mounted in this tool spindle **20**. The clamping anchor **46** comprises a center part **48** which is guided in the central section **40** of the coaxial recess **32** and carries on its end facing away from the tool **22** a clamping anchor head **50** which is of larger diameter than the center part **48** and is guided in the widened section **36**.

This clamping anchor head **50** comprises on its side facing the stepped surface **38** an annular surface **54** extending as far as a circumferential surface **52** of the center part **48** and delimiting together with the circumferential surface **52** of the center part **48**, the stepped surface **38** and the widened section **36** of the coaxial recess **32** a first cavity **56** of a first pressure cylinder formed by the tool spindle **20** and the clamping anchor **46** slidingly displaceable therein. To enable perfect operation of this first pressure cylinder, the center part **48** is provided with an annular seal **58** which is effective relative to the central section **40** of the coaxial recess and the clamping anchor head **50** is provided with an annular seal **60** which is effective relative to the widened section **36**.

The clamping anchor **46** itself is provided with a central bore **62** which extends through the clamping anchor **46** from the clamping anchor head **50** end and into which a sealing screw **64** is screwed in the region of the clamping anchor head **50**. Connecting channels **66** arranged in a region of the center part **48** facing the clamping anchor head **50** extend from this central bore **62** in a radial direction to the first cavity **56**.

A piston **68** is sealingly guided in the central bore **62** on the tool side of these connecting channels **66**. The piston **68** defines a second cavity **70** which is delimited, on the one hand, by the piston **68** and, on the other hand, by the sealing screw **64** and by a bore section **72** of the central bore **62** located between these two.

The piston **68** itself is acted upon from its side facing the tool **22** by a piston rod **74** which extends away from the piston **68** through the central bore **62** in the direction of the tool **22**.

Towards the tool **22**, the clamping anchor **46** is provided with a threaded bore **76** into which the central bore **62** extending from the clamping anchor head **50** passes, the threaded bore **76** being of larger diameter than the central bore **62**.

The piston rod **74** is of such dimensions that it protrudes out of the central bore **62** into a second threaded section **78** of the threaded bore **76** adjoining the central bore **62**. This second threaded section **78** is followed in the axial direction towards the tool **22** by a first threaded section **80** of the threaded bore **76**.

The tool, i.e., in this case, the grinding disc **22** is held by means of a clamping flange **82** which is part of a retaining device designated in its entirety **84**. This retaining device **84** comprises a retaining screw **86** which by means of a threaded bolt **88** can be screwed into the threaded bore **76** from the tool **22** end. This threaded bolt **88** of the retaining device **84** is adjoined by a cylindrical piece **90** which carries on its end located opposite to the threaded bolt **88** a circular disc-shaped screw head **92** which extends substantially parallel to the flange **24** and has a diameter which is approximately comparable therewith. This screw head **92** acts via an axial thrust bearing **94** arranged on its side facing the flange **24** upon the clamping flange **82** which in order to hold the grinding disc **22** clamps the latter between itself and the flange **24** designed as abutment.

A sleeve **96** surrounding the cylindrical piece **90** is formed on the clamping flange **82** and rotatably mounted on the cylindrical piece **90**. This sleeve **96** carries an external toothing **98** which can be brought into engagement with the internal toothing **42** of the toothed section **44** of the coaxial recess **32**. Hence the sleeve **96** is axially displaceable into the toothed section **44** but held therein in a rotationally fixed manner relative to the tool spindle **20**.

In the embodiment illustrated in FIG. **1**, both the screw head **92** and the clamping flange **82** have the same diameter and both are provided on their radially outward surfaces with respect to the axis **30** with a toothing **100** and **102**, respectively, both of which are of identical design. The two toothings **100**, **102** preferably have teeth arranged at an angular spacing of approximately 5 degrees. An internal toothed rim **104** of a cap **106** can be brought into engagement with these teeth. The cap **106** engages over the screw head **92** on its end face **112** facing away from the tool **22** and over both the screw head **92** and the clamping flange **82** in the region of their radially outward toothings **100** and **102**, respectively.

This cap **106** is mounted by means of a pin **108** on the retaining screw **86** by this pin **108** engaging an internal bore **110** extending from the end face **112** into the retaining screw **86**. The entire cap is thereby displaceable in the direction of axis **30** by the pin **108** guided in the internal bore **110** and so the internal toothed rim **104** is in engagement either with the toothing **100** of the screw head **92** only or with both the toothing **100** of the screw head **92** and the toothing **102** of the clamping flange **82**.

To enable the cap **106** to be locked in its position in which it engages both toothings **100** and **102**, the pin **108** is provided with a first annular groove **114** in which a retaining ring **118** mounted in a circumferential groove **116** of the internal bore **110** engages when both toothings **100** and **102** are in engagement with the internal toothed rim **104**. The pin **108** is additionally provided with a second annular groove **120** in which the retaining ring **118** engages when the internal toothed rim **104** is in engagement with the toothing **100** only.

The embodiment according to the invention shown in FIG. **1** operates as follows:

In order to mount the grinding disc **22**, the entire retaining device **84** is removed by screwing the threaded bolt **88** out of the threaded bore **76**. A new grinding disc **22** can then be placed on the flange **24**.

The retaining device **84** is then inserted by the sleeve **96** formed on the clamping flange **82** being turned in such a way that its external toothing **98** comes into engagement with the internal toothing **42** of the toothed section **44** of the coaxial recess **32**. This sleeve **96** thus ensures that the clamping flange **82** itself is rotationally fixedly connected with the tool spindle **20**. With the cap in engagement with the toothing **100** only, the retaining screw **86** is then screwed with its threaded bolt **88** into the threaded bore **76** of the clamping anchor **46**. The threaded bolt **88** is first screwed into the first threaded section **80** and subsequently reaches the adjoining second threaded section **78**. Once the threaded bolt **88** reaches this second threaded section **78**, it acts with its front surface **122** upon the end of the piston rod **74** facing the front surface **122** and hence via the piston rod **74** also upon the piston **68**. In the inventive solution, this is the case when the retaining screw **86** with the threaded bolt **88** has been screwed in so far that the clamping flange **82** rests on the grinding disc **22** and also brings it into abutment with the flange **24**, the clamping

flange 82 being acted upon by the screw head 92 via the axial thrust bearing 94. If the clamping flange 82 already rests against the grinding disc 22 before the front surface 122 has come into contact with the piston rod 74, then the clamping anchor 46 is pulled in the direction of the tool 22 until the motion of the clamping anchor 46 itself and the displacement of pressure transfer medium from the first cavity 56 to the second cavity 70 via the piston 68 have brought the piston rod 74 into contact with the front surface 122. The reverse procedure occurs when the front surface 122 rests against the piston rod 74 before the clamping flange 82 brings the grinding disc 22 into abutment with the flange 24.

If the retaining screw 86 is screwed further from this point on, then, on the one hand, the threaded bolt 88 draws by virtue of engagement in the threaded bore 76 the entire clamping anchor 46 in the direction of the flange 24 and so the first cavity 56 of the first pressure cylinder is reduced in size as the annular surface 54 and the stepped surface 38 are moved towards each other. At the same time, however, the front surface 122 presses the piston 68 in the direction of the clamping anchor head 50 via the piston rod 74 and so the second cavity 70 is similarly decreased in size.

In an advantageous embodiment, the first cavity 56, the second cavity 70 and also the connecting channels 66 are filled with a plastic substance, preferably a polyvinyl chloride with a relatively low degree of polymerization. This plastic substance is subjected to pressure by the decrease in size of the first cavity 56 and the simultaneous decrease in size of the second cavity 70 as the retaining screw 86 is screwed further in, and so this plastic substance attempts to move the clamping anchor 46 in its entirety away from the flange 24 and thereby exerts an additional axial pulling force on the retaining screw 86 and so the latter presses the grinding disc 22 firmly against the flange 24 via the axial thrust bearing 94 and the clamping flange 82 and hence clamps the grinding disc with the necessary force between clamping flange 82 and flange 24.

The advantageous effect of the two cooperating pressure cylinders is to be seen in the fact that when the threaded bolt 88 begins to act with its front surface 122 on the piston rod 74, a slight turning of the retaining screw 86 reduces both the first cavity 56 and the second cavity 70 in size and thus prestresses the plastic substance with high forces and, in addition, the transmission ratio between the effect of the piston 68 with a small piston surface and the annular surfaces 54 and 38 acting as large piston surfaces is effective. The plastic substance also has a certain elasticity and hence serves as elastic element which is volume-compressible within certain limits and thereby allows the grinding disc 22 to be held clamped when the retaining screw 86 is in the tightened state.

In addition to this, while the machine is running, the tool spindle 20 and hence also the plastic substance warm up and the latter then expands and, consequently, increases the force on the clamping anchor 46. To enable the tightened state of the retaining screw 86 to be fixed during operation of the inventive angle grinder, the cap 106 is tightened and subsequently displaced so far in the axial direction that its internal toothed rim 104 also engages the toothing 102 so that the screw head 92 is no longer able to rotate relative to the clamping flange 82. The clamping flange 82, in turn, is rotationally fixedly held on the tool spindle 20 by engagement of the external toothing 98 with the internal toothing 42 of the tool spindle 20 and, therefore, in all, rotation of the screw head 92 relative to the tool spindle 20 is no longer possible.

In a second embodiment of the inventive solution, illustrated in FIG. 2, insofar as the same parts are used as in the first embodiment, these bear the same reference numerals and, therefore, reference is made to the first embodiment for a description of these.

In contrast with the first embodiment of the inventive angle grinder, a piston ring 130 extending between the widened section 36 of the coaxial recess 32 and the circumferential surface 52 of the center part 48 is provided at a distance from the stepped surface 38. The piston ring 130 acts as a seal between these two surfaces and is supported by means of Belleville washers 132 on the stepped surface 38. Consequently, the first cavity 56' of the second embodiment is not delimited by the stepped surface 38 but by a piston ring surface 134 facing the annular surface 54.

The purpose of the Belleville washers 132 is to act as additional elastic element when the retaining screw 86 is tightened so that when the threaded bolt 88 acts with its front surface 122 upon the piston rod 74, further turning through a considerable angle is still possible because tightening of the retaining screw 86 is not delimited by the elasticity of the plastic substance but instead upon further tightening, the Belleville washers 132 are first compressed until the piston ring 130 is supported by the stepped surface 38 via the compressed Belleville washers 132. Only after that does slight compression of the plastic substance arranged in the first cavity 56', the second cavity 70 and the connecting channels 66 occur in order to achieve final clamping of the grinding disc 22.

In addition, the axial thrust bearing 94 is sealed off against soiling by a felt ring 95 surrounding it.

In a third embodiment of the inventive device, illustrated in FIG. 3, insofar as the same parts are used, these bear the same reference numerals and, therefore, reference is made to the first embodiment for a description of these.

In contrast with the first and second embodiments, the retaining screw 86 in the third embodiment does not press with its front surface 122 on the piston rod 74. Instead, the retaining screw is provided with an axial bore 140 which extends through it and has an internal thread 142. A threaded spindle 144 which extends through the entire axial bore 140 and acts upon the piston rod 74 with its end 146 facing the piston rod 74 can be screwed into this internal thread 142. The threaded spindle 144 is provided with an actuating wheel 148 which is arranged on a side of the screw head 92 located opposite the clamping flange 82. By turning the actuating wheel 148, the threaded spindle 144 can be screwed into the internal thread 142 until the actuating wheel 148 rests against the screw head 92. On the other hand, the spacing of the actuating wheel from the screw head 92 can be increased by screwing the threaded spindle 144 out of the internal thread 142.

In addition, the actuating wheel is covered by a cap 106' which has an internal toothed rim 104' which can be brought into engagement with both a radially outward toothing 150 of the actuating wheel 148 and a radially outward toothing 152 of the screw head 92, but by axial displacement of the cap 106' away from the actuating wheel 148 is only in engagement with the toothing 150 so that the actuating wheel 148 is freely rotatable relative to the screw head 92.

In the third embodiment, the grinding disc **22** is secured in the following way: First the threaded spindle **144** is screwed out so that the actuating wheel **148** is spaced from the screw head **92**. The screw **86** with the threaded bolt **88** is then screwed into the threaded bore **76** until the clamping flange **82** brings the grinding disc **22** into abutment with the flange **24** and, in addition, the end **146** of the threaded spindle **144** rests against the piston rod **74** and begins to act upon it.

In this state, the screw **86** itself is not screwed further, but only the actuating wheel **148** is turned so that the threaded spindle **144** is screwed into the internal thread and its end **146** presses the piston rod **74** and the piston **68** in the direction of the clamping anchor head **50**. The second cavity **70** is thereby reduced in size and the displaced plastic substance attempts to expand in the first cavity **56**, which results in slight displacement of the entire clamping anchor **46** away from the flange **24** and hence in movement of the entire screw **86** with the clamping flange **82** in the direction towards the flange **24**, whereby the grinding disc **22** is firmly clamped. The actuating wheel **148** is preferably screwed in until it comes to rest against the screw head **92**.

In the above-described clamping within the scope of the third embodiment, in particular, the transmission ratio between the piston surface of the piston **68** and the annular surface **54** and also the stepped surface **38** is effective. This is preferably chosen in the order of magnitude of 1:10 so that the screwing-in of the actuating wheel **148** with the threaded spindle **144** results in ten times the clamping force at the screw head **92** and hence at the clamping flange **82**.

In this screwed-in state, the actuating wheel **148** can, in turn, be secured in a rotationally fixed manner on the screw head **92** itself by displacement of the cap **106'** in the direction of the screw head **92** and so loosening of the actuating wheel is prevented during operation of such an angle grinder.

In this third embodiment, the recess **32** of the tool spindle **20** is advantageously closed at the end **34**.

The present disclosure relates to the subject matter disclosed in German Application No. P 38 00 437.2 of Jan. 9, 1988, the entire specification of which is incorporated herein by reference.

What is claimed is:

1. Device for clamping a disc-shaped tool on a motor-driven tool spindle of a portable machine, tool comprising:

a grinding disc on an angle grinder;

a clamping anchor arranged in said tool spindle which has an axial recess, said clamping anchor being axially displaceable relative to said tool spindle and rotationally fixedly connected to said tool spindle;

a clamping flange releasably attachable to the free end of said clamping anchor;

an abutment arranged at the tool end of the tool spindle;

means actuatable by a manual actuating mechanism operable tool-free for releasably pressing said clamping flange against said abutment, thereby clamping said tool between these said means for releasably for releasably pressing comprising:

a first pressure cylinder including a first cavity (**56**) between said clamping anchor (**46**) and said tool spindle (**20**);

a second pressure cylinder including a second cavity (**70**) arranged in said clamping anchor (**46**) or said tool spindle (**20**); and

a connecting channel (**66**) between said two cavities (**56, 70**);

said second pressure cylinder including a piston (**68**) delimiting said second cavity (**70**), and in order to releasably clamp said tool (**22**), said piston (**68**) being adjustable and fixable in its position in which it clamps said tool (**22**) by said manual actuating mechanism from a tool end of said tool spindle (**20**);

said first cavity (**56**) defined by delimiting surfaces (**38, 54**) of said tool spindle (**20**) and said clamping anchor (**46**), with said delimiting surfaces facing one another and being arranged in axially spaced relation to one another;

said manual actuating mechanism being operable via a retaining device (**84**) for securing said clamping flange (**82**) on said clamping anchor (**46**);

said retaining device being releasably attachable to said clamping anchor (**46**);

said manual actuating mechanism comprising an adjustable clamping member (**86, 144**) acting upon said piston (**68**) in order to effect clamping;

said clamping member (**86, 144**) being arranged on said retaining device (**84**); and said retaining device including:

a clamping member (**86**) which is securable against axial displacement in a positively connected manner on said clamping anchor (**46**); and

said clamping member (**86**) being securable by a securing element (**106**) which is displaceable in the axial direction.

2. Device as defined in claim **1**, characterized in that said first cavity (**56**) is defined by delimiting surfaces (**38, 54**) of said tool spindle (**20**) and said clamping anchor (**46**), with said delimiting surfaces facing one another and being arranged in axially spaced relation to one another.

3. Device as defined in claim **2**, characterized in that said delimiting surface (**54**) of said clamping anchor (**46**) faces said tool (**22**) whereas said delimiting surface (**38**) of said tool spindle (**20**) faces away from said tool (**22**).

4. Device as defined in claim **1**, characterized in that adjustment of said piston (**68**) is carried out via a bore (**62**) which is open at the tool end and extends in said clamping anchor (**46**) or in said tool spindle (**20**) as far as said piston and through which said manual actuating mechanism extends.

5. Device as defined in claim **4**, characterized in that said manual actuating mechanism is accessible for operation from the side of said tool (**22**) facing away from said tool spindle (**20**).

6. Device as defined in claim **1**, characterized in that said manual actuating mechanism is arranged in a tool end region of said clamping anchor (**46**) or said tool spindle (**20**).

7. Device as defined in claim **1**, characterized in that said manual actuating mechanism comprises an adjustable clamping member (**86, 144**) which acts upon said piston (**68**) in order to effect clamping.

8. Device as defined in claim **7**, characterized in that said clamping member (**86, 144**) comprises a surface which is oriented at an incline to a direction of adjustment of said piston (**68**).

9. Device as defined in claim **7**, characterized in that said clamping member (**86, 144**) comprises a thread.

10. Device as defined in claim 7, characterized in that said manual actuating mechanism is operable via a retaining device (84) for securing said clamping flange (82) on said clamping anchor (46), said retaining device being releasably attachable to said clamping anchor (46), and further characterized in that said clamping member (86, 144) is arranged on said retaining device (84).

11. Device as defined in claim 7, characterized in that said manual actuating mechanism is operable via a retaining device (84) for securing said clamping flange (82) on said clamping anchor (46), said retaining device being releasably attachable to said clamping anchor (46), further characterized in that said retaining device (84) includes a retaining member (86) which is securable against axial displacement in a positively connected manner on said clamping anchor (46), said clamping member (144) is adjustable relative to said retaining member (86).

12. Device as defined in claim 11, characterized in that said clamping member (144) can be screwed into said retaining member (86).

13. Device as defined in claim 11, characterized in that said clamping member is a threaded spindle (144) with an actuating element (148) which protrudes beyond said retaining member (86).

14. Device as defined in claim 11, characterized in that said clamping member (144) is rotationally fixedly securable on said retaining member (86) by a securing element (106').

15. Device as defined in claim 1, characterized in that said retaining device (84) includes said clamping flange (82).

16. Device as defined in claim 1, characterized in that said retaining member (86) can be screwed into said clamping anchor (46).

17. Device as defined in claim 16, characterized in that said manual actuating mechanism comprises an adjustable clamping member (86, 144) which acts upon said piston (68) in order to effect clamping, and further characterized in that said clamping member and said retaining member are the same screw (86).

18. Device as defined in claim 17, characterized in that said screw (86) can be screwed into a first (80) and an adjoining second threaded section (78) of said clamping anchor (46), and in that said piston (68) is actuatable during the screwing into said second threaded section (78).

19. Device as defined in claim 1, characterized in that said clamping flange (82) is held in a rotatable manner on said retaining member (86) and in such a way that it can be acted upon by said retaining member in the direction of said tool (22).

20. Device as defined in claim 19, characterized in that an axial thrust bearing (94) is arranged between said retaining member (86) and said clamping flange (82).

21. Device as defined in claim 19, characterized in that said clamping flange (82) is rotationally fixedly securable on said tool spindle (20) by positive connection elements (42, 98).

22. Device as defined in claim 1, characterized in that said clamping member (86) is securable in a positively connected manner on said clamping flange (82).

23. Device as defined in claim 1, characterized in that said first and said second cavities (56, 70) and also said connecting channel (66) are filled with a plastic substance for hydraulic pressure transfer.

24. Device as defined in claim 23, characterized in that said plastic substance is polyvinyl chloride with a relatively low degree of polymerization.

25. Device as defined in claim 1, characterized in that said first cavity (56), said second cavity (70) and said connecting channel (66) are filled with a viscous substance.

26. Device as defined in claim 25, characterized in that said viscous substance is a silicon substance, in particular, a silicon lubricant.

27. Device as defined in claim 1, characterized in that an elastic element (130, 132) permitting axial displacement of said clamping flange (82) relative to said tool spindle (20) is provided.

28. Device as defined in claim 27, characterized in that said elastic element (130, 132) is compressible up to inelasticity during clamping of said tool (22).

29. Device as defined in claim 27, characterized in that said elastic element is a volume-elastic element (130, 132) arranged in one of said cavities (56).

30. Device as defined in claim 1, characterized in that said securing element (106) is rotationally fixedly and axially displaceably held on said clamping member (86) or on said clamping flange (82) and can be brought into engagement with a toothed rim of said clamping flange (102) or of said clamping member (100), said toothed rim being coaxial with their axis of rotation (30).

31. Device as defined in claim 1, characterized in that said clamping member (86) is securable by a securing element (106) which is displaceable in the axial direction, and further characterized in that said securing element (106) is lockable in its position in which it secures said clamping member (86).

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